SCIENCE.

FRIDAY, AUGUST 1, 1884.

COMMENT AND CRITICISM.

WITH all the applause bestowed on Lieut. Greely and his comrades for their self-sacrifice and heroism, we hear continually the remark, 'I hope this is the last of arctic explorations.' This is not a strange utterance to proceed from those who have given no thought to the magnitude of the problems involved in modern polar research. One can even smile when a person who has never considered the subject says with spontaneous humanity, "Such expeditions may be very good for science, but they are very bad for men." But it is astounding to read the words which are attributed by the interviewer to the president of the United States when he heard of the rescue of the Greely party. He is reported by the New-York *Herald* (July 18) to have said that he "had never favored these explorations, as the geographical and scientific information secured could not compensate for the loss of human life. He could not see what had been gained, so far, that would justify any men, however ambitious and daring, in making another attempt."

For the following reasons, we take a very different view of such expeditions. The public need to be reminded, to begin with, that science is not a person, a party, or a society, that has 'interests' to promote. Science is accurate knowledge, systematically arranged by men for the good of men. To promote science is to promote an understanding of the world in which man dwells. Every great discovery in science sooner or later proves to be for the good of man. A great philosopher once said, 'There is nothing so prolific in utilities as abstractions;' and, if this be true, the intimations that discoveries may be 'good for science, and bad for mankind,' are based upon a fundamental error, which should always be met with a protest.

Again: there is a strong presumption when ten of the most enlightened governments in Christendom (England, France, Germany, Austria, Russia, Denmark, Sweden, Norway, Holland, and the United States) are persuaded by men of the greatest wisdom and knowledge, at the suggestion of one who knew by personal experience the hardships involved (the explorer Weyprecht), to engage simultaneously in a certain line of investigation — we say there is a strong presumption that the investigation thus proposed is of profound importance to the world. In this case the problem is one which every intelligent man can appreciate: it is nothing less than to increase our knowledge of the physics of the globe; to gather such facts, from so many places and by such careful methods, as will throw light upon the fundamental laws of terrestrial magnetism, and upon all the forces which govern the winds, the currents, and the ice-floes of the northern hemisphere. The chief result in view is not that which attracts the most applause; it is not the indication on our maps of a few more miles of land, nor the carrying of our flag to a point a little nearer the pole than any flag has ever been: it is the addition to science of observations made daily during a period of well-nigh two years, in a station most inaccessible, but most wisely chosen for comparison with a dozen other stations where like observations have been in progress.

This contribution to human knowledge may, as the decades roll on, and it becomes a part of the capital of the world, yield the most abundant fruits. It was obtained, it could only be obtained, by the bravery, the intelligence, the self-sacrifice, of heroic men, sustained by governmental aid, strengthened by the consciousness that other men were else-

where engaged on the same humane service. Greely and his associates took their lives in their hands for the good of humanity, as the soldier does when he enters the army, as the physician when he studies the scourge, as the missionary when he penetrates the dark continent, as the navigator when he enters unknown seas. Some of the number have fallen without reaping the rewards of their enterprise; some are returning with emaciated forms; all bravely did their part, and will be honored by their countrymen. 'Peace has its victories as well as war;' and those who have fought frost and famine, who have endured the hardships of three polar winters, that they might add to human knowledge, deserve the lasting gratitude of all thoughtful men. In days when luxury and comfort chain so many people to the fireside, and when the occasions for heroic action are so rare, it is good for human nature to witness fresh examples of heroism, all the better that these examples are for the sake of advancing science. All honor, therefore, to Greely and his brave companions, living and dead; and honor, too, to Schley and his crew for the rescue they effected with so much skill. Now that these men have reached the ports of their native land, there should be a better welcome for them than disparaging remarks, and the hope that there will be no more such efforts. 'Let knowledge grow from more to more,' and let those who extend its boundaries by hardships and bravery have their honorable places in the annals of science, and be welcomed without reserve when their arduous exploits are concluded.

As THE season approaches when our scientific men congregate for consultation upon matters of common interest, it may be well to call their attention to a small matter, which is really of more consequence than would at first appear; namely, to the practice of repaging authors' extra copies of articles published in journals and transactions of learned societies. The practice here complained of must occasionally be annoying to physicists, and, indeed, to every one who wishes to cite correctly, or to look up the references of previous writers; but it is severely felt by naturalists, who have so many names to cite or refer to, and to whom correct bibliography, and prompt and right reference, are essential. In the case of an actual reprint in an independent form, there may be good reason or necessity for repaging; yet even then the original pagination should be indicated. But in printing extra copies from the original type, there is no such necessity, and no real advantage: on the contrary, much disadvantage and confusion arises when a paper is cited from the journal or transactions of a society to which it was contributed, but under wrong pages. Some societies and journals refuse to have the original pagination removed; and, in our opinion, all should do so. Separate paging in addition may be permitted; but it were better to dispense even with this.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Light in the deep sea.

PROFESSOR Verrill's article in *Science*, No. 74, suggests the inquiry whether the faint light that he supposes to penetrate the deep seas may not have some rays of nearly all colors, and appear greenish to the deep-sea dwellers merely from an excess of rays of more rapid vibration, just as the sky appears blue from an excess of blue rays, not from the absence of other colors; and, further, whether the light reflected from the bright red or orange-colored animals that have been dredged from great depths does not give a many-colored spectrum, as is often the case with colored objects, so that, even when illuminated by greenish light, such animals would not necessarily be dull or black or invisible, but might be distinctly colored. If these questions were answered affirmatively, the explanation of the colors of deep-sea creatures by the operation of protective imitation would not be simple. W. M. DAVIS.

Cambridge, July 12.

The long-continued 'bad seeing.'

'A fellow of the Royal astronomical society,' in the *English mechanic and world of science*, vol. xxxix. p. 345, writes, —

" . . . As to the bad definition incident on the visibility of the afterglow, I should like to remark, that, for some time past, *daylight* definition of celestial objects has been worse than ever I remember it during my tolerably long observing experience. Transit-taking in daylight, save with the larger stars, has been quite impracticable, and over and over again I have looked in vain for Mercury. Of course, every one who is in the habit of using a telescope in the daytime is familiar with the fact, that on many seemingly cloudless days there is an otherwise invisible kind of haze, which impairs or destroys definition, and that the best or brightest vision is obtained in the blue sky visible between large, floating annuli; but this curious obscuration has

been just as apparent during the latter condition of the atmosphere as during the former. Hasn't the Krakatoa dust all settled down yet?"

Another observer (p. 322) bears witness to this 'continued and oftentimes peculiarly bad definition;' and Mr. W. S. Franks, in writing to the same journal (p. 416), attributes it 'to the unusually dry season.' Perhaps those who are working upon the subject of the 'Krakatoa dust' can give some explanation of this exasperatingly persistent *bad seeing*. For months past it has been noticed here by all who have had occasion to observe in the daytime, and, indeed, I noticed it myself in the autumn of 1883; but I was not particularly struck with it at the time, as at certain seasons of the year we are in the habit of expecting a smoky atmosphere and poor definition, on account of forest-fires or other causes. As the bad seeing has continued even down to the present date, we cannot account for it in this way.

The haziness is usually confined to the south of our zenith (I am speaking more especially of meridian observations), and is most marked in the neighborhood of the sun. The sky is white, though this whiteness is sometimes barely perceptible, and the stars are unsteady. Stars of the third or fourth magnitude, which have frequently been seen on a good observing day in other years, it is almost useless to try for now. That the phenomenon is not local seems evident from the remarks of the English observers quoted above; but has it been noticed by others in widely different latitudes?

WILLIAM C. WINLOCK.

Washington, D.C., July 22.

AN IDEAL UNIVERSITY FROM AN ENGLISH POINT OF VIEW.

AN article in a recent number of the *Contemporary review*, by James Bryce, on 'An ideal university,' is well deserving the attention of Americans, all the more because its author is an Englishman, writing with immediate reference to the wants of the city of London. He has, however, by repeated visits to this country, become familiar with what we are doing, and he possesses that truly philosophic mind which is quite as ready to gather suggestions from the experiments of a new state of society as from old-world experience. An active member of Parliament, a professor of Roman law in the university of Oxford, the writer of an historical work of remarkable power, accustomed in his wide range of travels to observe with discrimination the influences of different religions, laws, and educational systems upon the life of the people, he combines in an exceptional way the wisdom of a scholar with that of the man of affairs. His plea is for an organization in the city of London which shall be a true university, not a corporation holding examinations and conferring degrees, like the actual university of London, not a fellowship of colleges, not a group of museums and libraries; for all these are in existence. His plea is for something different from, if not higher and better than, any or all these agencies: it is a plea for that higher and better organization which thoughtful Americans in all parts of this country are trying to develop.

'What is an ideal university?' asks Mr. Bryce. The answer which he gives has in it nothing of novelty, nothing of eccentricity, nothing beyond the reach of a wealthy community. It is the answer of common sense, directed by experience, to the solution of a very important problem. It is the answer which has often been given before, but rarely in such persuasive and intelligible phraseology. Assuming that a university is a body of men engaged in teaching the highest knowledge, and is therefore something very different from Carlyle's 'true university, a collection of books,' he claims that breadth is the first essential,—catholicity, universality. He would have it include not only the subjects which are traditional (languages, mathematics, and theology), but the social sciences (politics and comparative jurisprudence), the sciences of observation and experiment, and even the applied sciences. In this last suggestion he is broader than most Germans, for they have hitherto inclined to teach the applied sciences away from the universities, in polytechnic and *real* schools. Americans have often, though not always, inclined to follow this German precedent; and those who hold the opposite view will be fortified in it by this word of Mr. Bryce.

The next essential of the ideal university is freedom. The writer plants himself firmly, and without reservations, on the doctrine that any one who comes may study any subject he pleases, whether or no he studies any other subject, or enters for a regular course. He would let the university prescribe its course or courses, and give its honors and degrees in accordance with such restrictions. "Place

guard, if you like," he says, "at the doors of your examinations; but let your lecture-rooms stand always open, like the churches of Catholic Europe, so that thereby even the passing wayfarer may hear the voice and be drawn in." With the main intent of this remark, most of our colleges agree, opening their halls to special students; but it may be as well to make a note of caution on the margin of what we read, lest the impression should be given that 'happening in' to an occasional lecture makes the scholar. The regular and persistent attention to a serious subject is the first element of success in university-work. The group of occasional attendants or special students in our colleges, according to our experience, includes a few of the very best, and some of the very worst, who ever enter the academic walls.

The third essential of the ideal university, according to Mr. Bryce, is that it should teach. This pointed remark is obviously directed to the idea, which has been more developed in England than anywhere else, that the chief function of the university is to examine students, and confer degrees. This is the avowed end of the university of London and of the Royal university in Ireland. In years gone by, even the universities of Oxford and Cambridge left the principal work of instruction to the colleges, reserving the prerogatives of holding examination and bestowing degrees.

These three elements — breadth, freedom, and teaching-force — are the essentials of a university. Supplementary powers are the bestowal of honors (if it is thought worth while to maintain the system of academic rewards), the prosecution of research (which will take care of itself, if teachers of real ability are secured), and, finally, the acquisition of endowments (on which Mr. Bryce lays but little stress).

On the subject of endowments, Mr. Bryce writes like one who has seen the evil which comes from the long perpetuity of individual whims; and he boldly declares that the principle should once for all be laid down, that charitable endowments belong, not to the dead, but to the living, and that each generation shall be free to use them for such objects as it finds most presently beneficial. These considerations ought to be weighed and discussed in the United States, where every year new and generous endowments are made for charity and education. One enlightened giver, whose name we could mention, having had his attention called to this point, expressly provided that the million which he gave, might, after a certain period, be applied by his trustees to a purpose akin to the original object, but not identical with it, if in their judgment such a course would be wise. The difficulties experienced at Andover and at Exeter in the management of the Phillips funds are examples of the celerity with which conditions become fetters.

Bryce's main doctrine is, that the ideal university must 'give first-rate teaching.' This, undoubtedly, is the true doctrine. But how are first-rate teachers to be developed or discovered, and how are they to be kept 'first-rate' under all the counteracting influences to which they are exposed? There's the rub. On these points we should like to hear further from Mr. Bryce. Shall only men of genius be chosen professors? There are not men of genius enough to go round. Shall practical instructors, those who are well versed in didactic methods, be preferred? The faculty which is filled up with such men will be governed by routine; it will have neither *éclat* nor inspiration: it will be like a military school, — a place for training, not a place for the development of great minds. But suppose first-rate teachers are secured, men who have some genius and some common sense, how are they to be kept 'first-rate'? We reply, The university is responsible for its treatment of its professors. They must be kept at work, in actual instruction, or they will grow indolent and sterile; they must have considerable leisure, or they will not think and write and investigate, but will simply be repeaters of old stories; they must have ample supplies of books, journals, instruments, for these are the diet on which they grow; they must have stimulants, the best of all being the attention of bright and

growing scholars around them, the next being a consciousness that they are responsible for what they do to the world of science and letters, and not merely to their own colleagues and followers; and, finally, they must not only be fairly paid, but must be protected from temptations to every form of extravagance in the employment of their resources. Such are some of the difficulties which are to be encountered when the simple idea of 'first-rate teaching' is expanded.

All that Mr. Bryce says about the end of an education is excellent: "It is not to train students merely as lawyers, physicians, clergymen, engineers, bankers, merchants, and statesmen, but as men; and the best thing the university can do for them is to form in them what we will call the philosophic mind."

THUNDER-STORMS.

Benjamin Franklin once remarked, in substance, sadly to a friend, "It is now eight years since I showed that mankind could be protected from the danger of lightning by lightning-rods; yet there is hardly a house in Philadelphia provided with them." The heart of the great American philosopher would be greatly warmed if he could perceive the activity of his disciples, who waylay every builder of a house, and awaken fears where all was peace before. There is no question oftener asked of the professor of physics than this: "Shall I put lightning-rods on my house, and, if I erect them, what should be their form and position?" Personally I have given the following abbreviated answers. "If your house is surrounded by tall trees, or if there are higher houses in your immediate neighborhood, I should trust to the trees, or kindly leave the expense of the lightning-rods to your neighbor. If your house stands alone, a prominent point in the landscape, on a cliff, or remote from trees, I should be in favor of a properly placed lightning-rod. I should place two or three pointed rods three or four feet above the highest point of the house; allow the metallic rod, which should be at least one-half a square inch in section, to rest, without glass insulators, upon the house; connect all the tin sheathing, the copper gutters, the gas and water pipes, with this lightning-rod; and conduct the latter, by the shortest course possible, to *wet earth*."

These answers seldom conclude the correspondence, however, although one generally prefers to leave to the neighbor the expense of erecting lightning-rods. One brings instances of houses having been struck which are situated lower than one's neighbors, and are surrounded with tall trees which over-topped the houses; and one asks with a shudder, "Can I connect my gas-pipes with a lightning-rod?" Indeed, the writer or would-be authority on lightning-rods has not an easy life before him. He must not only satisfy the timid heart of the believer in him, but he must also fight with all his knowledge the brazen limb of ignorance and superstition, who starts with the postulate that no scientific man knows any thing concerning thunder and lightning, and that the true knowledge has been revealed only to himself while working in a cornfield. It is not long since, that an American professor of physics was sued for twenty or thirty thousand dollars damages for maintaining that the members of a lightning-rod company which placed lightning-rods like a letter U upon the roofs of houses were practically quacks; the theory of this lightning-rod being, that the lightning, if it struck one point of the U, would be dissipated into the air from the other point. There is a lightning-rod company in Massachusetts at the present time which erects lightning-rods on the theory that lightning always seeks electrical earth-currents; and, if there are earth-currents beneath a house, that house should be protected, and the rods led into the path of the earth-current. If, on the other hand, no earth-currents run near the house, such a house is safe, and needs no lightning-rods. The electrician of this firm is self-taught: there are no books on electricity in his library. He discovers the earth-currents by a forked stick. Not deterred by the fact that there is no evidence to prove that a discharge takes place between a charged cloud and a current of electricity in the ground, and, moreover, no evidence to prove that earth-currents move in regular paths through the earth, and, indeed, no *conclusive* evidence of the existence of earth-currents, he persuades even the so-called practical electrician to rearrange the lightning-rods on his house.

The student of electricity is therefore called upon to assert the grounds of his belief: and he finds it difficult to convince his audience; for they are, in general, not sufficiently conversant with electrical phenomena to appreciate his arguments. The position taken by most professors of physics on the subject of lightning-rods is based upon the experiments of Franklin, in which he showed that pointed metallic rods,

so to speak, facilitated electrical discharges; the experiment of Faraday, by which it was shown that a person, and even the most delicate electrical instruments, inside a large metallic cage which was connected with the ground, were unaffected by powerful discharges of electricity between the cage and the prime conductor of an electrical machine; and the statistics collected by the English government, which show, that, since vessels have been provided with lightning-rods, the number of casualties produced at sea from lightning have been greatly reduced. A building covered by a metallic netting suitably connected with the ground would be well protected from lightning. The nearest approach to this condition of safety would be to connect all the network of metallic conductors about a house with wet ground; and one argument against placing under ground the network of telephone and telegraph wires in cities is, that at present, where they are very numerous, they protect buildings from danger from lightning. This is, of course, not the case where a single telephone or telegraph wire enters a house. The latter should always be well connected with the gas or water pipe. In regard, however, to the belief that tall trees, higher than the houses in their immediate neighborhood, protect the houses, we can point to the well-known efficiency of small points in facilitating electrical discharges by slow degrees. Each leaf and twig is such a small point. Moreover, during a rain, the dripping from the leaves reduces the electrical charge on the tree to the same sign and amount as that of the air in the immediate neighborhood, as is shown by the well-known experiment of Sir William Thomson, in which an insulated can, from which a stream of water issues in drops, is connected with an electrometer; and the latter shows that the metallic can has taken the charge of the air in its neighborhood. The drops of water continually reduce the can to the electrical potential of the neighboring air. The tree, therefore, can be looked upon as a more important electrical factor than the few salient lower points of a building.

It is safe to affirm that not one out of a thousand lightning-rods at present upon our buildings are of any use, for the simple reason that they are not led into moist ground, and therefore offer great resistance to the passage of an electrical discharge. Any one can be convinced of this by scraping the lightning-rod at any point, connecting a bright wire at this point, and, having led the other end of the wire to the water-pipe or to a body of water, placing one or two Leclanché cells in this circuit, and leading the wire in a north and south direction directly over an ordinary pocket-compass. If the lightning-rod enters moist ground, or makes a connection with the earth, the compass should indicate an electrical current by its deflection. Generally it will be found that no such earth-connection exists, and the lightning-rod is therefore worse than useless. It should be immediately connected with the water-pipe, or with a spring, or some body of water. To illustrate the fact that the mere entrance of a metallic rod into the ground is not enough to insure the passage of an electrical discharge to the ground, drive two metallic rods into your lawn, at any suitable distance apart; connect them by a wire, which includes a Leclanché or other voltaic cell; and, having led the wire over a pocket-compass in a north and south direction, see if you obtain a deflection of the needle. If, moreover, you labor under the delusion that a surface-sprinkling of the earth near the rods will give an electrical connection, it is best to perform the experiment. It is probable that several acres of lawn would have to be thoroughly sprinkled before a suitable earth-connection could be obtained. A few experiments with a modern electrical machine — a Toepler-Holtz machine, for instance — will readily convince one of the effect of points in dissipating an electrical charge, and of the fact that an electrical discharge always takes the path of least electrical resistance between two points. Having ascertained these facts, one has acquired all the intellectual capital that is possessed by most lightning-rod men. If one apparently discovers that gilded lightning-conductors, or twisted ones, have peculiar attractions for the electrical discharges, one leaves the sure ground of fact for the region of the unproven. The difficulty in our study of thunder-storms is, that we cannot experiment on a sufficiently large scale, and our means are too tardy to allow us to follow the exceedingly rapid changes of electrified bodies. What we call freaks of lightning are merely the expressions of electrical laws, combined with the laws of elasticity of matter. The forked lightning-discharge is an expression of the fact that a positive charge is combining with a negative charge along a path of least resistance; and the air is fractured, so to speak, by the compression, just as a plate of glass yields in zigzag cracks when it is supported on one edge, and a force of compression is applied to the other edge. The influence of the medium through which the electrical discharge takes place can be readily

seen by obtaining the electrical discharge in different gases, such as carbonic-acid gas or nitrogen, and comparing these photographs with those taken in free air. Although we can study certain phenomena of atmospheric electricity successfully in our laboratories, yet we cannot charge a cloud with positive electricity, and fill the sky with different strata of hot and cold air. It is generally believed to-day among scientific men, that the electricity of thunder-storms cannot be attributed to sudden evaporation or condensation of moisture; for direct experiment has failed to reveal any electricity which is due to these causes. Mr. Freeman made many delicate experiments in the physical laboratory of Johns Hopkins university to decide the question whether evaporation produces electricity, and he could find no evidence of any that was due to this cause. Herr Kayser has also lately experimented at the physical laboratory of Berlin upon the electrical effects of condensation, with negative results. Personally I feel that all the experiments hitherto conducted on the electricity due to evaporation and to condensation have been conducted on too small a scale to test the question; and I do not see how they can be conducted on a larger scale. When we think of the immense plan upon which these operations are conducted in nature, of the evaporation from every square foot of the ocean, and of the rapid condensation through miles of space, we can realize that an infinitesimal amount of electrical charge, too small to be detected in a laboratory, might be integrated into a large amount, and, becoming localized, might produce the tremendous electrical disturbances which we witness in thunder-storms.

How, then, can we conduct future investigations upon thunder-storms? The most promising direction for scientific work seems to be in the establishment of systematic observations on thunder-storms, and on atmospheric electricity in general, over a large tract of country. In certain regions, thunder-storms follow certain definite paths, and other tracts are never visited by them. There is a general impression that electrical storms are, in common language, attracted by rivers, and are more severe about large bodies of water in general. However this may be, nothing but systematic daily simultaneous observation, long continued, can increase our knowledge. If the government, in connection with the signal-service, should establish a number of electrical stations throughout the west and south, where thunder-storms and tornadoes are so frequent, daily thunder-storm maps might be issued, showing the probable path of the electrical disturbances. Perhaps we should then see, in districts peculiarly infested by thunder-storms, certain 'insurance-against-danger-by-lightning retreats,' in which Benjamin Franklin's lightning-rod should rise from a small hut, completely covered with a network of metallic rods which are connected with running water or a large extent of moist earth. These safe retreats would certainly be a great desideratum for many who now suffer greatly from nervous terrors during thunder-storms.

John Trowbridge.

THE FORMATION OF CAÑONS AND PRECIPICES.

One of the most remarkable natural objects in the state of New York is to be seen at the crossing of the Genesee River, at Portage station, on the New-York, Lake Erie, and western railroad, 362 miles from New-York City, and 83 from Buffalo. The railway here spans a deep gulf on an iron bridge 820 feet long and 235 feet high, near the upper end of a wonderful cañon. There are three falls of the river immediately below the bridge, measuring 60, 90, and 110 feet respectively. The gorge runs out in the Genesee shales at Mount Morris, being 20 miles long by the meanderings of the river, which falls 500 feet in that distance. In some places the banks are 350 feet high, nearly perpendicular, and the ravine is wholly impassable. It is a fine example of the work of water; and there are hundreds of others in that state, on a smaller scale, in the upper part of the Portage group. One of these is the celebrated Watkins Glen, a beautiful cañon two miles long, with a succession of cascades. The neighboring glen at Havana is very similar; and there are a number of others farther north, several of which may be seen at Big Stream, Rock Stream, Dresden, and other places. Taghanic and Lodi Falls, and the glens and ravines about Ithaca on Cayuga Lake, and many other similar places, are all on the Portage formation, which forms a narrow east and west band across western New York. It might be added, that both Seneca and Cayuga Lakes are, in part at least, simply old Portage glens, now filled with water. To many reflecting persons who, as summer tourists, visit these very curious and beautiful resorts, the thought occurs, why these cañons are in these particular places above all others, and how they have been caused, the work of glaciers, or some convulsion of nature, being

the common explanation; and amateur geologists puzzle themselves about their origin. It looks as though there was something special about the Portage group of rocks, everywhere abounding, as it does, in glens, gorges, and cañons, to which the formation of these remarkable places is due. Why is the Portage, of all the ten or twelve formations in this state, the favorite one for these phenomena, being composed, as it is, of sandstones and shales very similar to those in other localities where nothing of the kind is found?

The explanation is simple enough; namely, that it is owing to the peculiar alternation of thin beds of soft shale and harder sandstone rocks, and the presence of a stream of water running into lower ground, which performs the work of erosion, and the size of which must be adapted to the work; and upon that, too, the size of the gulf depends. Beginning at the lower end or mouth of the present cañon, the action of the waterfall first removes a little of the softer layers of shale, leaving the thin beds of harder sandstone projecting for a time, which, in their turn, are also broken off from want of support, in masses small enough to be entirely carried away by the stream, especially during the winter floods; thus preventing the formation of a slope, and exposing the bottom of the falls to another erosion. Thus, by the recession of the falls, the cañon is formed, provided another requisite is afforded; namely, that the side-walls must maintain their erect position: otherwise a valley, instead of a cañon, is formed.

This raises another question; namely, why do not these precipitous side-walls, composed of apparently soft rocks, slope themselves down, and form well-rounded hills, as they do elsewhere? The answer is, because the harder layers of sandstone form what a mason would call 'the binders,' which hold the natural wall in its upright position. The erosion of the cañon is done by the stream of water undercutting, like the work of the coal-miner, and then breaking down, the unsupported 'top-bench;' while, in the mean time, the action of the air and frost on the side-walls is so much slower than that of the stream of water, that, while the latter is rapidly cutting back, and making the ravine longer and deeper, the sides remain in their original upright position. As the falls recede, and a thicker sandstone or shale rock occurs, without the proper alternation of strata, it will form the permanent upper end of the gulf, which will be a precipice if it is a sandstone, and a slope if it is a thick bed of shale. It thus happens that the Portage portion of nature's masonry, and the necessary streams of water passing over it, are nicely adapted to the formation of glens and cañons. In localities where there are no streams of sufficient size passing over the Portage group to a lower level, as on the summit levels, there are high hills, it is true, but no glens or gorges. The eroding action of the elements being more uniform over the whole surface, and the transporting power of a rapid stream to carry away the falling fragments being wanting, therefore slopes, instead of precipices, are there produced.

There are also, in the state of New York, limestone glens, as they might be called, which are due to the same cause. At Trenton Falls, on the Utica and Black-River railroad, eighteen miles north of Utica, East-Canada Creek has cut a narrow passage, three miles in length, through the Trenton limestone, the formation being named from this locality. It is a cañon with vertical walls a hundred feet high, in which are the celebrated and very beautiful falls. The cause of the erosion is, that the limestone rock is in thin layers, of from six to ten inches thick, separated quite regularly by thin layers of shale of about the same thickness. It is owing to this regular mixture of hard and soft rock, in alternate courses, that the stream has been able to wear away the rock by undermining the shale into a succession of cascades; and, what is equally important in forming a cañon, the stream, a wild torrent from the Adirondack forests, is large enough to carry away the fragments of the overlying limestone as fast as it gives way. After cutting its channel back to a village called Prospect, a thicker and harder layer of gray limestone is encountered, which has stopped the recession of the falls, the stream being unequal to its destruction; and that is the end of the ravine.

The gulf of the Genesee River from Rochester to Lake Ontario was caused in the same way: for although the rocks are much thicker and stronger than any of those above referred to, yet the river is a correspondingly larger stream, and was able to cut through the alternating beds of Medina, Clinton, and Niagara limestone, shale, and sandstone; and the flood of water is powerful enough, with the aid of the fall below, to carry away the material, and prevent the formation of a talus.

At Niagara Falls and the gorge below, in the same formations as at Rochester, is a repetition of the same operation on a vast scale; and as the river there is larger than the Genesee, so the cañon is also longer, deeper,

and more thoroughly cut down, the river's wearing and transporting power being in proportion to the great beds of shale, sandstone, and limestone.

In many localities in the state of New York and elsewhere, there are glens and ravines cut wholly out of the Genesee and Hudson River shales, where there are no alternations of hard and soft strata, as in the Portage. Precipitous hillsides are also of frequent occurrence, although the face of the rock soon turns to soil. The reason why the edge of apparently so soft a rock of such fine material withstands the weather, and presents these naked sections for such a length of time in mural banks in ravines, river-courses, and upon the shores of lakes, is on account of its uniformly foliated structure. A very slight examination will serve to show the thin laminae of which the entire rock is composed, like sheets of paper, reminding one of the resisting power of the edge of a book. The hardness of some kinds of coal is also owing to its laminated formation. A precipitous wall, whether built by nature or by art, must either be laid with a good cement, or it must be composed of material having a good bed, 'breaking joints' both inward and laterally.

A peculiarity of the loess or bluff formation on the Mississippi and Missouri Rivers is, that although it is very fine, soft, and easily excavated with the spade alone, yet it presents very steep slopes and precipices resembling those of solid rocks. Unlike all other formations of an earthy nature, it remains unchanged by the atmosphere and the action of frost. Road-cuts and embankments, however steep, stand for years like a wall; and wells dug in it require to be walled only to a point above the water-line, while the remainder stands so securely without support, that the spade-marks remain upon it for years, although it is not at all cemented together. In the city of St. Joseph, and all other places where the bluff formation is found, these peculiarities can be easily seen; and they appear very remarkable to an eastern man, accustomed to the sloping down of banks of sand and clay. The explanation of it is, that, as is well known, the bluff is a lacustrine deposit. The material forming it floated in flakes in a quiet, shallow lake. The minute particles, assuming a flattened form, however it may have been caused, were very quietly and gently deposited in layers, like little sheets of paper. There was no current, no movement of the particles to form rounded grains of sand, irregularly deposited in accidental disorder. On the contrary, the bluff is a well-built piece of miniature natural earth masonry, well bound together: hence there is no rolling tendency in the material, and, when cut down at right angles to the layers, it does not form a slope, like other kinds of earth. Thus, from precipices of rock of the heavier strata to those composed of the smallest, their mechanical structure is of great importance, and the same homely comparison of the 'stretchers and binders' of an artificial wall applies.

JAMES MACFARLANE.

Towanda, Penn.

THE EQUATORIAL COUDÉ.

IN spite of the loss of light in the two reflections from its mirrors, — which loss will vary with the condition of the reflecting silver films, but, under the best conditions, should not much exceed twenty per cent, — the equatorial coudé of the Paris observatory would seem to be the coming form for nine-tenths of the equatorial work of an observatory. This form of 'elbow equatorial' has been described of late in so many scientific periodicals, that it is sufficient here to say that the polar axis forms a part of the tube, at the upper end of which the observer sits like a microscopist at his desk, and at whose lower end a 45° mirror turns the course of the rays into a tube at right angles to the axis; and at the outer end of this tube is the objective, with still another 45° mirror outside of it, which turns round the axis of this tube. This gives the motion in declination, and the rotation of the whole round the polar axis gives the motion in right ascension. All the movements, the reading of all the circles, the illumination, and every thing connected with the management and use of the telescope, are directly under the observer's control as he sits at his desk, where there is every facility for attaching spectroscopic, photometric, and micrometric apparatus to the eye-piece end, which keeps its fixed position. Moreover, the observer and all this accessory apparatus can be entirely roofed in, and the room warmed in cold weather, if desired, and the observer made as comfortable, and the work as convenient, as that in any laboratory, while the whole heavens are at his command.

There can be no question as to the desirability of this, when compared with the discomfort and exposure in the common observatory dome, and with the difficulty of attaching accessory apparatus to, counterpoising, and using it upon, the moving end of an ordinary equatorial. Still further, the observing-room can be made entirely dark when desired; and the increased sensitiveness of the retina, under these circumstances, will be a great gain in delicate spectroscopic and photometric work. Also, in work upon the sun, the possibility of protecting the accessory apparatus entirely from the sun's direct rays, and even of working in the dark if desired, will be a great improvement upon the inconveniences unavoidable in the common observatory dome.

The important point is, whether equally good definition can be attained with these two extra reflections. Experience alone can decide this with certainty; but up to the limit already tried in the Paris instrument, about ten inches aperture, we have the strongest evidence of its possibility. Dr. Gill, astronomer at the Cape of Good Hope, in describing to the Royal astronomical society a flying visit to continental observatories, speaks of the Paris equatorial coudé as follows: —

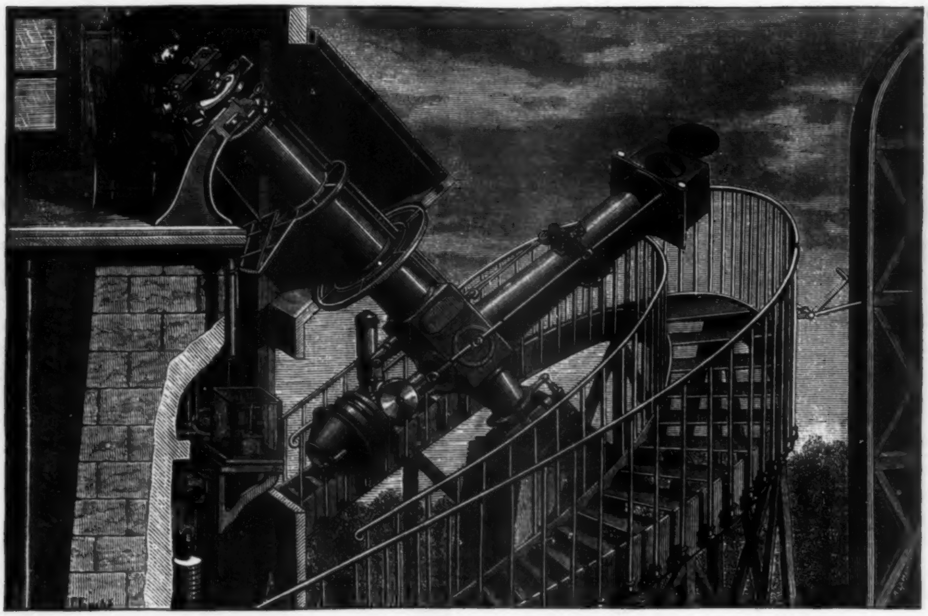
"One fine night, about eleven o'clock, we went to the observatory, and set on γ Leonis; and I am bound to say I never saw the diffraction-disks of a star better defined than in that instrument. They were perfectly circular. The disks came as sharply to focus as any I ever saw; and I would not have believed, if I had not seen it, that it was possible to make an instrument in which, after two reflections, such definition could be found. I am bound to say I never saw better definition in any instrument, and I never measured a double star so pleasantly and easily before."

Dr. Gill's well-known investigations in stellar astronomy give to whatever he says in this line great weight, and no stronger testimony could be desired.

When it comes to the question of the largest apertures, it would seem, *a priori*, that there should be no difficulty in making a glass mirror — where the internal constitution of the glass is not in question, and only one plane surface is demanded — 1.41 times as large as an objective, in which the glass of the two lenses must be homogeneous throughout, and four perfect surfaces are required.

Also it would seem, that if large lenses, whose thickness is limited, can be supported at the rim so that the distortions due to gravity are not appreciable in the definition, then mirrors whose thickness is unlimited, and which can be supported in every possible way at the rim, and all over the back surface, might be made sufficiently rigid to resist distortion. To be sure, the effects of distortion are of quite a different order in the two cases, the effect of gravity in increasing the curvature of one side of a lens being partly counteracted by the diminished curvature of the other side, while the distortion of a single reflecting surface appears with its full effect in the definition. But the far greater facilities for making the mirrors rigid should make up for this in a large degree. At any rate, the French opticians seem to have full confidence in their ability to do this, and it is certainly to be hoped that they will succeed.

Washington. H. M. PAUL.



EQUATORIAL COUDÉ AT THE PARIS OBSERVATORY. (Reproduced from *l'Astronomie*.)

THE ECHINODERMS DREDGED BY THE TALISMAN.[1]

AMONG the deep-sea echinoderms, some of the holothurians attain a large size, one being seventy centimetres long. The mouth is situated at one end of the body, although near the termination of the

[1] Abridged from the French of H. FILHOL in *La Nature*.

intestines, which open at the other end of the creature, are the orifices of branching tubes forming the respiratory organs. When holothurians are disturbed (as on being caught, for instance), they contract, and suddenly shoot out their viscera. But what is more singular and inexplicable is, that after some time these organs are reproduced. It would seem that the life of these animals, at whatever depth, would pass in perfect quiet; yet the holothurians living near the surface, as well as those between four and five thousand metres, are harassed by a swarm of parasites. Thus some of them, as Van Beneden says, are transformed into a kind of living hotel; some lodge in their respiratory organs little fishes (Ferasfer) with a body as long as that of an eel, but contracted; others shelter one or more couples of the little crabs called Pinnotheres, or carry in their intestines the worms called Anoplodium. But besides these parasites, which do not live at the expense of the host, of whom they demand only a home, there are others which live on the host.

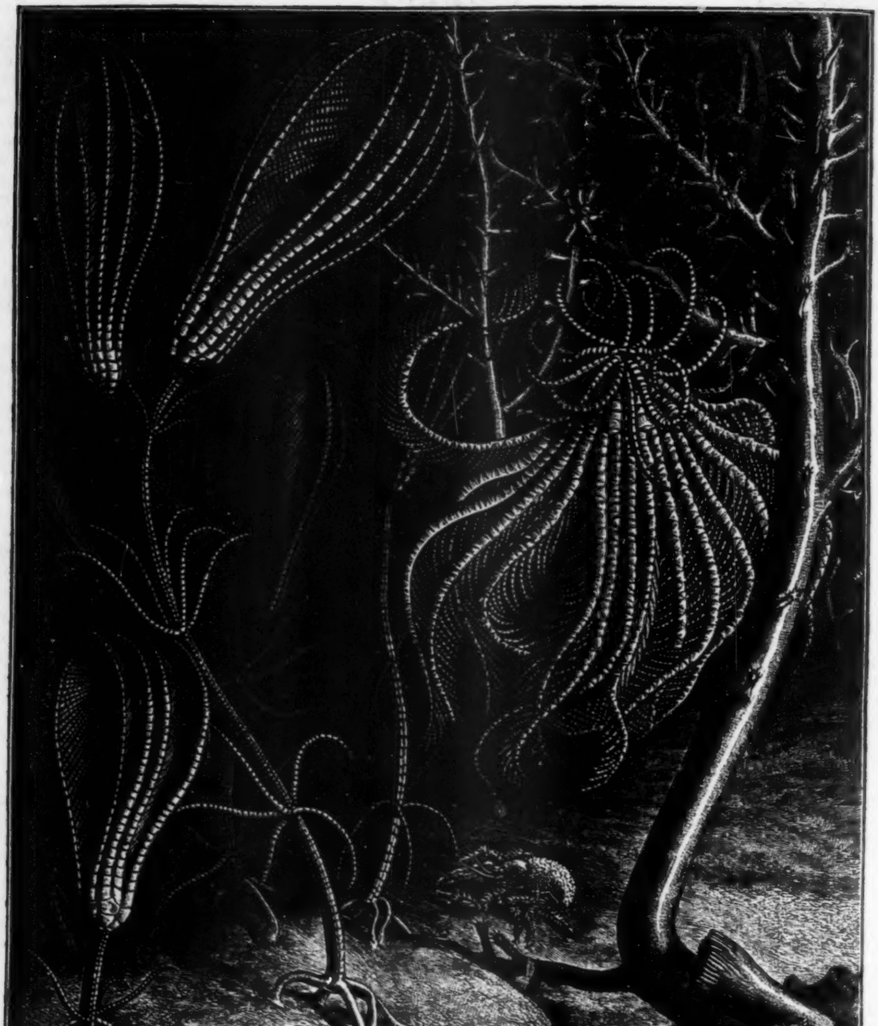
Perrier says, "A holothurian has essentially the form of a five-sided melon with an opening at each extremity. With holothurians of great depths, however, this form almost entirely disappears. Some curve themselves back into a U-shape; others, as Ankyroderma, have the form of an ovoid sac, without the ambulacra which cut the surface of the other holothurians into five arms; the majority, instead of the characteristic radial symmetry of their allies, present a bilateral symmetry as distinct as that of the worms and the vertebrates, and creep on the mire by means of a ventral sole, like slugs, forming a peculiar example of the mode in which two organic types which seem separated by an unbridgable abyss may be found in the same animal."

The sea-urchins are represented at great depths by forms very varied, and peculiar to certain zones. Some are remarkable for the development and beauty of their spines. For a very long time the remains of a genus of echinoderms called Calveria had been found in cretaceous deposits; but only in 1869, during the cruise of the Porcupine, was the survival of this form at the bottom of our seas revealed to us. "As the dredge was coming in," says Thomson, speaking of this form, "we got a glimpse from time to time of a large scarlet urchin in the bag. We thought it was one of the highly coloured forms of Echinus Flemingii of unusual size; and as it was blowing fresh, and there was some little difficulty in getting the dredge capsized, we gave little heed to what seemed to be an inevitable necessity, — that it should be crushed to pieces. We were somewhat surprised, therefore, when it rolled out of the bag uninjured; and our surprise increased, and was certainly in my case mingled with a certain amount of nervousness, when it settled down quietly in the form of a round red cake, and began to pant, — a line of conduct, to say the least of it, very unusual in its rigid undemonstrative order. Yet there it was, with all the ordinary characters of a sea-urchin, its interambulacral areas, and its ambulacral areas with their rows of tube feet, its spines, and fine, sharp, blue teeth; and curious undulations were passing through its perfectly flexible leather-like test. I had to summon up some resolution before taking the weird little monster in my hand."

The flexibility of the sides of this particular echinus, as was discovered, is due to a peculiar arrangement of the pieces forming the test. As for the palpitation which seems to have so impressed the English naturalists, it is simply due to the ship's rolling or pitching, or else to the vibrations arising from the action of the engines on board.

A group most abundant in new forms is composed of the beautifully formed and often brilliantly colored animals called star-fishes. Attention must be directed first to Brisinga, which sometimes has as many as twenty long, flexible arms. These brilliant orange-red stars often violently detach their arms when they feel themselves caught and drawn up by the movement of the trawl; and it is very rarely that they can be studied in an uninjured state. Absjornsen, who first discovered them on the coast of Norway a little above Bergen, at a depth of 200 fathoms, much admired the phosphorescent light shed by the body and the arms. "Whole and uninjured as I saw it once or twice under the water in the dredge, this animal is peculiarly brilliant, a veritable *gloria maris*;" and he accordingly gave it the name Brisinga, from a jewel of the goddess Freya. Brisinga coronata was obtained at the tropics, hitherto found only in the German ocean. In the cruise of the Porcupine it was found at 914 metres. We found it between 736 and 1,435 metres. Other species occur at depths ranging from 882 to 3,455 metres. All these forms are new, and so abundant that thousands cover the bottom of the sea.

Crinoids, the last echinoderms of which we shall speak, are cup-shaped. From the edges extend simple arms, bifurcated or branched, with pinnules at the sides. From the back grows a jointed rod, which attaches itself to surrounding objects. In Antedon and Actinometra, represented on the plate, this rod exists only during an early stage, the body becoming free at a certain point in their development; while with Pentacrinus, also figured, and with Democrinus and Bathycrinus, it continues during the life of the animal. The crinoids have always been considered by naturalists interesting objects of study, as much on account of their rarity in the present marine fauna, as on account of their great abundance in very old geologic periods. In fact, these animals, which were common during the Silurian period, increased in numbers at the time of the calcareous carboniferous deposits, which are formed almost exclusively of beds composed of their remains. They were found again in abundance in that middle horizon of the triassic deposits called muschelkalk. After this time of extraordinary prosperity, crinoids appear, as Thomson says, to have gotton the worst in the struggle for existence. As they approach the present period, the species become rarer, and are represented by fewer individuals. At one time it was thought that Antedon alone existed at the present time. The discoveries made in the deep-sea explorations resulted



BOTTOM OF THE OCEAN AT A DEPTH OF 1,500 METRES, PEOPLED WITH PENTACRINUS, AND SHOWING ALSO SOME COELENTERATES (MOPSEA AND OTHERS) AND CRUSTACEANS.

in the abandonment of this idea. Certain forms of crinoids, as Pentacrinus, Democrinus, and Bathycrinus, are peculiar to great depths, and form in our seas numerous and widely separated colonies.

A recent species of Pentacrinus, a genus largely represented in the lias and oolite, was brought in 1755 from Martinique to Paris, and described by Guettard. At long intervals rare specimens from the Caribbean Sea have been seen. On the 21st of July, 1870, Gwyn Jeffreys, while dredging from the Porcupine at a depth of two thousand metres, in longitude 39° 42′, latitude 9° 43′, procured a score of specimens. It would seem as if their excellent state of preservation would prove whether they were free or fixed. Thomson, who studied them, believed that the animal lives slightly attached to the soft mud, changing at will its abode, and swimming by means of its feathery arms. On the Talisman, the trawl was twice dropped to depths occupied by this Pentacrinus; and we decided, contrary to the prevailing opinion, that these animals live firmly fixed by the backward-curving tendrils, which grow from the terminal joint of the rod. These hooks, as it were, solder themselves to the bottom, and can be detached only by breaking.

We have attempted to show in our plate the character of the bottom of the sea on which Pentacrinus lives, as it was shown by the dredging made opposite Rochefort, at fifteen hundred metres. Pentacrinus Wyville-Thomsoni in considerable numbers covers the ground, forming a kind of living meadow, from which rise large Mopseas. The rocky ground was covered with beautiful corals, resembling flowers with the calyx opened; and in the midst of this living world moved hitherto unknown crustaceans (Paralomis microps A. M. Edw.) whose carapace was ornamented with fine spines. Actinometra (crinoids which become detached from their rods after full growth) were floating in the water, or fastened themselves for short intervals by their tendrils to the branches of the Mopseas. Pentacrinus and Actinometra were of a beautiful grass-green, the Mopseas of an orange color, the corals of a deep violet, and the crustaceans of a mother-of-pearl whiteness. This profusion of life, and this prodigality of colors, at fifteen hundred metres below the surface, certainly form two of the most wonderful facts which have been reserved for the naturalist to discover.

In 1827 Thomson found attached to Comatulas (free crinoids with no attaching rod) a Pentacrinus of small size, which he described under the name of Pentacrinus europaeus. This animal seemed to possess, in all the details of its structure, the characteristics of the fossil Encrinus and of the modern Pentacrinus. Ten years later Mr. Thomson, when again examining a small crinoid, was much astonished to see it suddenly abandon its rod, and begin to swim with its arms for some time, and then to reattach itself by its tendrils. Continuing his studies, he saw the arms, originally branched at the summit, gradually assume the character of the arms of Comatula; and he was gradually brought to the knowledge that Pentacrinus europaeus was only a young Comatula.

Comatulas are numerous at certain points on our coast, where they are found, according to their age, gracefully clinging among the sea-wrack, or sheltered under the pebbles accumulated on the reefs. Several species descend to a considerable depth, one being found abundantly at twelve hundred metres. At some places we saw Comatulas existing by thousands, and representing almost exclusively the animal life of the locality.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New-York academy of sciences.

June 3. — Mr. G. F. Kunz read a paper on a new process of cameo or intaglio gem-engraving, in which he said, that, from his first experience in the dental chair, he received the impression that the machine used in tooth-drilling would be the proper one for engraving and cutting on stones similar to cameos and intaglios. In the engraving-lathe at present used, the tool revolves on a horizontal shaft, to which are attached tools of different size and shape; the Italians and French using a screw-thread, while the English make use of a lead head, which is simply fastened in by the revolving of the wheel. A set of tools or drills often numbers over a hundred. Mr. Kunz exhibited the S. S. White improved dental engine, which is somewhat similar to the other machines in use, and may be described as follows: A driving-wheel eleven inches in diameter is set in motion by a foot-treadle; and from this wheel the power is conveyed, by means of a cord of fibre or thin leather, to a pulley-head. To this is hinged a pivot-rod, extending from it as a flexible arm, which conveys the power to the drill through a steel or iron head-piece. The main advantage lies in the revolving-point being allowed so much freedom of motion by the flexible wire arm, that it can be placed in any position desired, and held in any position on the work instead of the work being held on it. Any revolving-tool that can be placed at will on the work, in any desired position, gives the desired result; and this can be attained by a flexible driver, as in this machine. It might, however, be improved. 1°. The points or drills should be made of softer iron, to hold the particles of diamond-dust more readily. 2°. The tool should be arranged to work more steadily, and thus overcome any possible jar in very fine work, although it has drilled a series of holes in a metal plate, which no engraver with the old lathe could place more closely. 3°. The driving-wheel should be heavier and larger, to attain more

power and a greater rate of speed. 4°. The wheel and treadle should be placed under a bench, and the

THE WHITE DENTAL ENGINE, APPLICABLE TO GEM-ENGRAVING.

flexible arm passed through its centre, in front of the workman. A machine of this kind might be used for all rough grinding-out; or, for some of the fine work, a diamond-pointed tool, the diamond being the amorphous carbonado. This would in all respects be a miniature rock-drill. Mr. Kunz had no doubt that with this tool, the diamond being properly secured, any stone softer than diamond could be engraved much more readily than with any known drill; and that for engraving on diamond it could also possibly be used, since the amorphous diamond is really harder than the crystalline form of this mineral. As engraving on this gem has been much more in vogue of late than ever before, its use in this field, also, would be required. It could at least make the round furrows, such as in ancient times were made by the bow-drill, and afterward by the diamond or emery-stone point, and then polished out by the finer particles of these minerals. One great advantage of this method is, that the very pulsation, as it were, of the artist, will be conveyed to the drill, thus imparting to the stone whatever artistic feeling he may possess, instead of the mechanical, unartistic effect so common with the work of the old machine. By this method, should it be given a fair trial, not only will the style of work be likely to be greatly improved, but a rapidity of execution will be attained that has never been accomplished by the old lathe-machine, even by the best workmen. Who would think of a sculptor holding the statue against the chisel, or of a violinist rubbing the bow with the violin? And yet the present mode of engraving is quite correctly illustrated in these apparently extreme examples. The conveyance of the pulsation through such a machine as this is really the same as the inspiration which a musician or an artist conveys to his instrument, his brush, or pencil: it is what he *feels;* and the graver cannot convey this pulsation with the old lathe.

NOTES AND NEWS.

IN the article in our number of last week, on the organization of an international scientific association, no sufficiently distinct reference was made to the committee appointed by the American association. Dr. Minot has called our attention to the omission, which we endeavor to make good by the following statement. The committee referred to was appointed in 1882 at the Montreal meeting of the American association

for the advancement of science, "to confer with committees of foreign associations for the advancement of science with reference to an international convention of scientific associations." The committee consists of Dr. T. Sterry Hunt, Mr. Alexander Agassiz, and Professor Simon Newcomb. If the British association responds, as has been suggested, by also appointing a committee, the official channels for the interchange of opinion between the two national bodies will be suitably established on both sides. We are unable to make any authorized statement as to what the American committee has done or proposes, but its membership justifies the conviction that it is capable of efficient action, wisely planned. We shall await their report with interest.

— The circular of the Philadelphia local committee announces that the local and general secretaries of the American association will have their offices in the library of Horticultural hall. The post-office will be in the Academy of music, where letters bearing the initials A. A. A. S. will be delivered.

In section B, physics, electricity will undoubtedly be a prominent subject of discussion. In consequence of the provision of congress for the appointment, by the President of the United States, of a scientific commission to conduct a national conference of electricians and investigations related to the international electrical exhibition, it is probable that official conferences of electricians will be held immediately after the meeting of the association, so as to allow all visiting scientific men interested in this department to participate.

The president of section E, geology, suggests that the following order be observed in the reading of papers: 1°. Geography and stratigraphic (post-archaean) geology; 2°. Geology of crystalline rocks; 3°. Mineralogy and lithology; 4°. Paleontology; 5°. Quaternary geology; 6°. Miscellaneous. As a large number of papers is expected, it is suggested that special days be assigned to the above topics in the order given. The subject of crystalline rocks will form a special topic of discussion. The presence of a number of British geologists will add unusual interest to the occasion. Special geological excursions will be arranged to places of interest in the vicinity.

It is proposed to effect an organization in section C, chemistry, under the title of the sub-section of agricultural chemistry. All chemists interested in the application of the science to agriculture are invited to attend this convention of agricultural chemists, to be held Monday evening, Sept. 10. The Association of the *American journal of agricultural science* will also meet during the week, and all persons interested in promoting this enterprise are invited to attend.

Special efforts have been made to render the meetings of section D, mechanical science, of unusual importance, invitations having been sent to a large number of specialists and mechanical and engineering societies to participate. Papers are expected on the subjects of standard bars, flat surfaces, screws, etc. Room will be provided for the erection of apparatus.

All botanical members are requested to call at the Academy of natural sciences as soon as practicable after arrival, and register: this will constitute them members of the American botanical club of the association, which was instituted at the Minneapolis meeting, and entitle them to the privileges of the same. Special excursions will be organized to the Bartram gardens, the pine barrens of New Jersey, and other localities of botanical interest.

It is expected that an effort will be made toward the formation of a sub-section on meteorology.

The proposed organization of an International scientific association will be brought forward for discussion. It is hoped that the British association also will take some action during its session at Montreal, to enable it to unite with the American association in a common effort to found such a congress. Those who are interested in the undertaking, who can make any suggestions or desire information as to the plans formed, are invited by the local committee to communicate with Dr. Charles S. Minot, No. 25 Mount Vernon Street, Boston, Mass., who, in accordance with the wish of the permanent secretary, has assumed charge of the correspondence relating to this matter. In this connection it is worthy of note that the local committee has sent invitations to more than two hundred foreign societies, inviting them to send representatives to Philadelphia. A number have accepted; and this increase in the number of foreign scientific men will add to the importance of the movement. Among the American societies which will meet simultaneously in Philadelphia are the American institute of mining engineers, the American institute of electrical engineers, the Pennsylvania state agricultural society, the Agassiz association, and the Association of collegiate alumnae. For all business concerning papers, membership, etc., address F. W. Putnam, Hotel Lafayette, after Aug. 20; and for all local business, transportation, and rooms, address local secretaries, H. C. Lewis and E. J. Nolan, at the Academy of natural sciences.

— The President has selected the following as members of the electrical commission to conduct experiments on the occasion of the exhibition at the Franklin institute: Prof. H. A. Rowland, Baltimore; Professor John Trowbridge, Cambridge; Prof. G. F. Barker, Philadelphia; Prof. R. A. Fisk, San Francisco; Prof. M. B. Snyder, Philadelphia; Prof. J. Willard Gibbs, New Haven; Professor Simon Newcomb, Washington; Prof. E. J. Houston, Philadelphia; Prof. C. A. Young, Princeton; Dr. W. H. Wahl, Philadelphia.

— Some weeks ago a plan for bringing certain subjects for debate before the chemical section of the American association for the advancement of science, at its approaching meeting in Philadelphia, was considered by the fellows of section C, and has resulted in the following selection: 1°. To what extent is the hypothesis of 'valence' or 'atomicity' of value in explaining chemical reactions? 2°. What is the best initiatory course of work for students entering upon laboratory practice, and what are the best methods of illustrating chemical lectures? These subjects, if

approved by the standing committee, will be offered for public discussion in the sectional meetings at such time as the committee may determine, probably on Monday and Tuesday, Sept. 8 and 9. In addition to the above, the following subjects have been carefully considered by some of the members, and papers or discussions on them may be expected, if the committee are able to arrange for them upon the daily programmes: Fermentation; Adulteration of food and drugs; Thermo-chemistry and chemical theory.

— With a view of more generally disseminating the results of scientific investigation, and of facilitating the work of the student in natural history, the following members and officers of the Academy of natural sciences, Philadelphia, have associated themselves into a bureau of scientific information, whose function shall be the imparting, through correspondence, of precise and definite information bearing upon the different branches of the natural sciences. It is believed by them, that, through an organization of this kind, considerable assistance can be rendered to those who, by the nature of their surroundings, are precluded from the advantages to be derived from museums and libraries. As the organization is of a purely voluntary character, it is to be hoped that no unnecessary burden will be imposed upon its members by communications of an essentially trivial nature. All correspondence must be accompanied by a return stamp (two cent), and may be addressed to the following: Joseph Leidy, M.D., Mycetozoa, Rhizopoda, Entozoa, Vertebrate paleontology; Edward Potts, Pond life, Fresh-water sponges, and Bryozoa; George W. Tryon, jun., Conchology; Benjamin Sharp, M.D., Worms, Annelids, Histology; G. H. Horn, M.D., North-American Coleoptera; H. C. McCook, D.D., Ants, Spiders, Insect architecture; Henry Skinner, M.D., North-American moths; Eugene M. Aaron, Diurnal Lepidoptera; W. N. Lockington, Echinoderms, Fishes; Spencer Trotter, M.D., North-American ornithology; Thomas Meehan, Exotic and cultivated plants; J. H. Redfield, Ferns and North-American phanerogamic plants; J. T. Rothrock, Vegetable physiology; F. Lamson Scribner, Grasses; H. Carvill Lewis, Mineralogy, Glacial and stratigraphical geology; Angelo Heilprin, Invertebrate paleontology, Physiography, Dynamical geology; D. G. Brinton, M.D., Ethnology, American linguistics, and Archeology; Harrison Allen, M.D., Teratology; J. Gibbons Hunt, M.D., Microscopical technology; E. J. Nolan, M.D., Bibliography of natural history; Professor Harrison Allen, chairman; Professor Angelo Heilprin, secretary. It is to be clearly understood that the scope of the organization does not embrace considerations of a purely professional character, such as mineral or chemical analyses, nor the determination of collections, except by special agreement. Departments not represented in the above titles will be filled as early as practicable: correspondence pertaining to such should be addressed to the secretary. In all other departments the respondents may be addressed directly, care of the Bureau of scientific information, Academy of natural sciences.

— Lieut. A. R. Gordon of the royal navy, superintendent of the Canadian meteorological service, sailed from Halifax, June 22, in the steamer Neptune, with a party of observers, to establish stations along the Hudson's Strait. The crew, with the explorers, will in all number fifty-five men. The expedition will first call at Nain, on the Labrador coast, and finally at Ramah, the northernmost station on the Atlantic coast, and but a few hundred miles south of Cape Chudleigh, at the entrance to the strait. Eskimo interpreters will be engaged at one or more of these Labrador stations. Seven stations in the strait will be established, as follows: No. 1, at Cape Chudleigh, at the south-east entrance of the strait; No. 2, on Resolution Island, at the north-east entrance of the strait, and about forty-five miles across from No. 1 station; No. 3, at Cape Hope, or on the south side of about the centre of the strait, and about two hundred and fifty miles from stations 1 and 2; No. 4, directly north of No. 3, on the Upper Savages Islands; No. 5, on the south-east end of Nottingham Island, and about two hundred miles from No. 4; No. 6, on the south side of Mansfield Island, and a hundred and fifty miles from No. 5; No. 7, at Fort Churchill, four hundred and sixty miles from No. 6.

— By order of the secretary of the navy, a board, consisting of Commodore Luce, Capt. Sampson, and Commander Goodrich, has reported upon the establishing of a post-graduate course, or school of application, for officers of the navy. It recommends that the leading subjects of the course should be the 'science and art of war,' and 'Law and history.' Subsidiary to these, instruction will be given in ordnance, torpedoes, and hydrography. These latter courses will consist partly of instruction in the higher mathematics and the physical sciences, and partly of practice at the Washington navy arsenal and experimental battery and the Newport torpedo station.

Only officers of and above the rank of lieutenant are to be allowed to take the courses. In the two main branches the students are to come to the school, and the subjects are to be taught by eminent specialists. For the instruction in science, the students must go to the instructors, wherever such and the necessary laboratories are to be found. For this and other reasons, the board recommends Newport for the site of the school, that the students in science may avail themselves of the facilities about Boston.

— The Detroit *Free press* reports a fall of a light dust on Lake Michigan on June 13. The dust covered the ground about Wangoshance lighthouse to the depth of an inch.

— The paper promised by Professor Bonney for the Montreal meeting of the British association will be on the archaean rocks of Britain, and not on the archaean rocks of Canada.

— The director of the meteorological observatory of Turin, Father Denza, is organizing observations on board the Godard captive balloon, which ascends to an altitude of two hundred to three hundred metres at the Turin exhibition.